Assessment of Fauna Density Along the Coastal Areas of Ras Laffan Industrial City, Qatar (Arabian Gulf)

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Abstract

A marine ecological survey was carried along the marine areas of Ras Laffan Industrial City to characterize the distribution of benthos at various locations on the east coast of Ras Laffan Industrial City. Sediment samples were analyzed and biota population was assessed. The polychaets were the most abundant group followed by gastropods on the northern side and their mean density/m. The Station A -5000, had the maximum number of animals per square meter (360/m^2). The fauna had 4 dominant species and the most abundant one was *Padina pavonia*. The polychaets, mollusks and crustaceans were the constant feature at all stations. Among the gastropods the most dominant species was *Cerithium* sp. and among the bivalves the most dominant ones were *Lithophaga* spp. All the specimens of stomatopods were monospecific (*Gonodactylus demanii*). The most abundant group on the eastern corridors was Gastropoda and the least abundant was Stomatopoda *Gonodactylus demani*. On the eastern side, the richest station was F 250 which had the maximum number of animals per square meter (1280/m^2). and the thinnest population is found at Station H 2500.

Key Words: Ras Laffan, Arid Zone, Coastal Development, Sediments, Benthos, Coastal Ecology, Biodiversity

Introduction

Ras Laffan Industrial City (RLC) is situated on the Northeastern side of Qatar along the Arabian Gulf in the State of Qatar occupying an area of 106 km^2 (Figure 1). Due to the prevailing geological, meteorological and oceanographic conditions, the coastal marine areas of Ras Laffan Industrial City are regarded as special marine environment. A combination of shallow waters, high temperature and salinity and other oceanographic features such as current and wave action exert their pressure on the marine ecosystem. The marine communities of the area are adopted to flourish in such harsh but fragile environment and the ecosystem, by the virtue of its unique nature, is vulnerable to external agents such as industrial discharges and accidental spills into the marine environment. Ras Laffan Industrial City has a coastline of 9 km on the northern side and 5 km on the eastern side.

The northern coastal areas of RLC display the following six different zones (Figure 2):

Inter-tidal Zone

The width of the inter-tidal zone vary from a few meters to a kilometer or more, although the coastal survey of the north shore found the area to be narrow with a marked gradient (URS

Dames & Moore, 2000). In the upper inter-tidal area, the substrate consisted of exposed bedrock, with much of area covered with a tar layer approximately 4-5 m wide and in some areas up to 2 cm thick. The lower inter-tidal zone is composed of a thin sandy substrate overlaying a hard substrate (beach rock) with many stones and gravel. Inter-tidal sediments are distinguishable by their light tan colour and by the many iron-stained root tubes and small holes that occur in them. Marine life in the lower inter-tidal environment zone is well developed and dominated by crabs, worms and gastropods. The shoreline survey noted green algae attached to the rocks and gravels, as well as the presence of small blocks of tar at all locations along this zone.

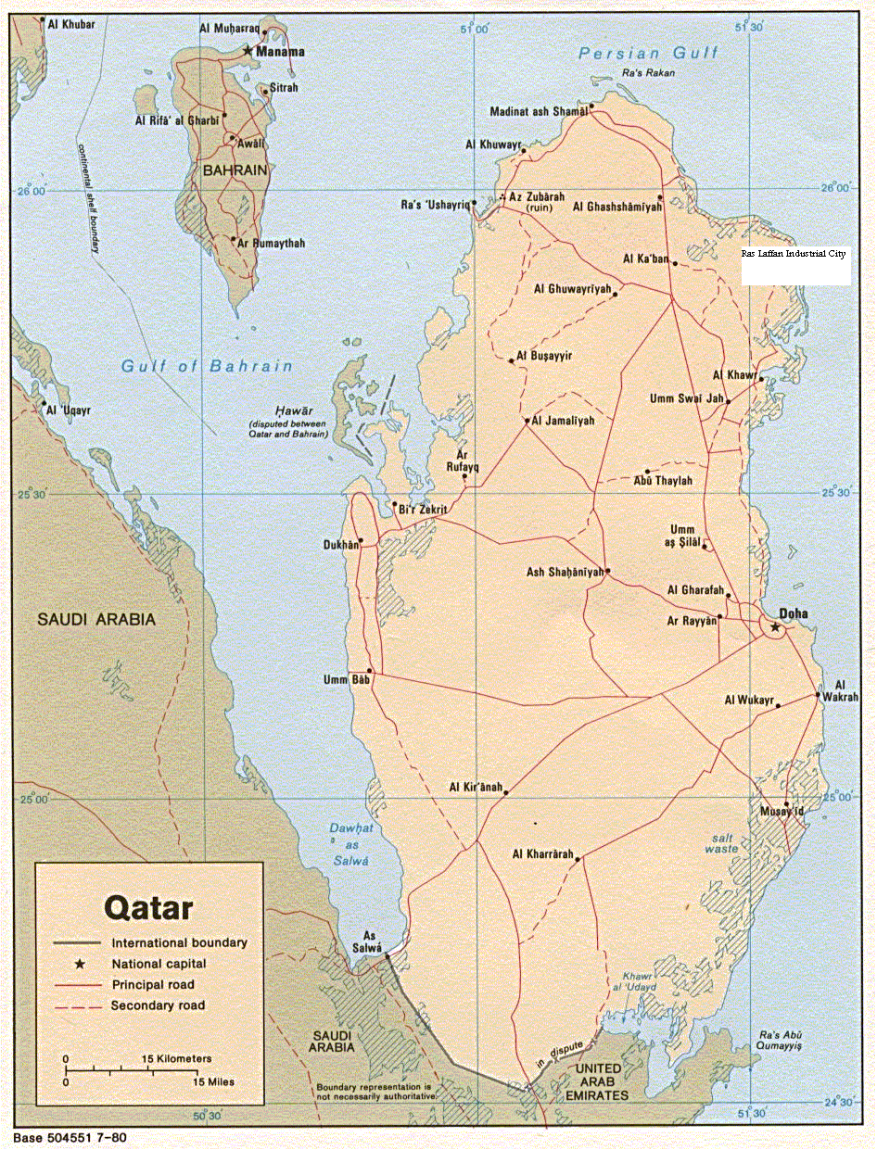

Figure 1: Location of Ras Laffan Industrial City

The Lagoon

The lagoon extends from the shoreline to the coral barrier (approximately 500 m wide). Water depth in the lagoon is shallow, probably not exceeding 1 m at low tide (URS Dames & Moore, 2000). The seabed sediments of the lagoon consist of mixtures of calcarenite and skeletal

calcarenite, interspersed with mixtures of marl. In these waters, the nature of the sediment varying dependant on current and wave action. These sediments have a general thickness of approximately 8 m (CH2M Hill, 1995). The lagoon acts as a shelter for a number of small invertebrates and is believed to play an important role as a nursery for many valuable species of fish. However, the abundance of organisms in the lagoon, including prey species for the fish populations, is limited by the fluctuation of environmental conditions in the shallow water (eg temperature).

Figure 2 Location of Coastal Habitats in the Study Area (SARC, 1999)

The Coral Barrier

A coral barrier extends parallel to the RLC northern coastline at a distance of some 500m from the shore, which is visible on satellite photographs of the area. The results of the sampling programme conducted during June 2000, showed the structure to be dead with blocks of dead corals present on both sides of Ras Laffan port. It is believed that these corals have been dead for some time. Species identified during the survey include *Acropora* spp., *Platygra* spp., and *Favorites* spp. However, whilst the coral is dead, the structure still plays an important role in the formation of the nearshore lagoon and in the protection of the shoreline from excessive wave energy (SARC, 2000d). The structure also forms a hard substrate for fixed flora (algae) and fauna (sponges, oysters, worms), making the area a rich food resource for coral reef species as crabs, urchins, cuttle-fishes and fish.

Similarly. the Hunting Surveys Limited (1985) Pipeline Route Survey extended from the North Field, approximately 85 km offshore, to a location 1.5 km offshore of a landfall point approximately 675 m north of the Ras Laffan Lighthouse. This survey showed coral fragments and calcareous sand from 1.5 to 2.5 km offshore, followed by a 500-m wide band described from

side-scan sonar records as a zone where coral growths occurred on the substrate surface. The depth at this location, approximately 3 km from shore, was 10 m. The 10-m depth range continued until approximately 5.5 km from shore. The remainder of the sea floor within the 10-m depth range (3.0 to 5.5 km from shore) was described as medium calcareous sand with shell fragments (Hunting Surveys Limited, 1985).

Shallow Sandy Zone
The shallow zone extends from between distances of 500 m and 1 km from the coastline, with the water depths ranging from between 1 and 4 m. The seabed is composed of mainly wide sand bars parallel to the coast which were formed by the swell currents. .

Offshore Deep Sandy Zone
This zone extends from approximately 1 km from the coastline to offshore. The seabed comprises of sand and gravel with some patches of small coral colonies (no more than 30 cm wide). Water depth ranges from between 3 and 5 m. These water depths and the distance from shore provides more stable conditions for life and consequently this zone is believed to be relatively rich in fauna.

East Coast

The structure of the east coast (southeast of RLC) differs from that of the north coast, as the absence of a coral barrier means that the area is exposed to the coastal currents and wave action in the area. The marine zone of the east coast mainly consists of a shallow sandy zone which covers the area from the shoreline to approximately 3 km distance offshore. The bottom consists of mainly sand and gravel. The marine survey (SARC, 2000d) showed a zoning of the area in three bands parallel to the coast:

Zone A
Close to the existing outlet and up to 50-100 meters offshore, the sea floor is made of pure sand marked by ripple-marks figures. This observation means that hydrodynamic energy is quite high and that sediment is very often moved, thus providing bad natural live conditions for fauna and flora. The observed fauna is then totally absent as it is buried fauna.

Zone B
From 50-100 meters to approximately 600-800 meters offshore, there are some small rocks or coral patches dispersed over the sand. This is evidence of a previous coral floor which has been re-covered by a quite dense layer of large algae.

Zone C
Over 600-800 meters offshore, the substrate is dominated by sand. The sand is quite different than in the zone close to the shore as it displays smooth ripple marks and appears to be richer in fine particles. This suggests a reduction of hydrodynamic energy and seabed disturbance. The consequence is the development of life over the sea-floor and especially many hermit-crabs or worms.

Methodology

In 2002 a marine ecological survey was initiated to assess change in biodiversity of the coastal areas of RLC and the location of the sampling sites is shown in Figure 3.

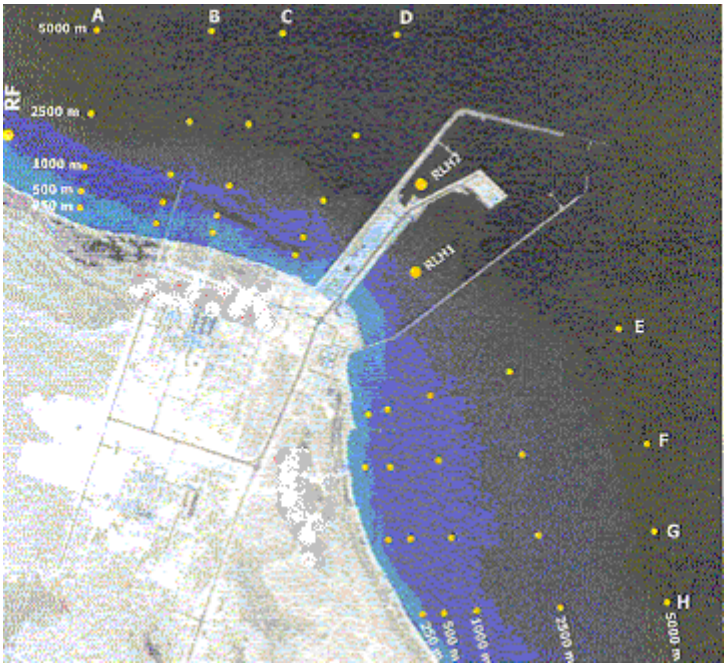

Figure 3: Location of Ecological Survey Stations

.**Methodology**

Before taking sediment samples from the designated stations underwater video of the bottom fauna and flora and of the sediment was taken without causing any disturbance. This done was to ensure that biota were video-graphed in their natural habitat with minimum disturbance. Similarly, underwater still photography of the bottom fauna and flora was also done at each station. Microphotography of some representative species of fauna and flora was done during biological diversity and density determination of the sediment samples.

Sediment and biota samples were collected from sampling locations. Due to heterogeneity in the distribution of the organisms samples from three different squares of the quadrate (1m x 1 m) lying flat at the bottom. Biota samples were collected and secured in HNO_3 treated plastic containers for metal analysis and also in glass containers for Total Petroleum Hydrocarbon (TPH) analysis. The quantity of sediment sample collected was measured in a graduated cylinder for total volume or with electronic balance for weight. Each sample was split into 3 portions. Approximately one-third of sediment was transferred to stick-on-plastic bags for the grain size analysis. Formaldehyde was added to all the samples assigned for qualitative analysis. The sampling equipment was washed in a tub with filtered sea water. The sample was then passed through sieves of different mesh size to sieve off the animals. Some of the samples were bulk stained using Rose Bengal (1 gm/L in formaldehyde). The material retained on the screen or sieves was transferred to polyethylene bags. Approximately 1 gm of $MgSO_4$ was added to the sample as a relaxant or for narcotizing highly contractile animals. The samples were mixed by inverting the container several times and left for approximately 30 minutes. The pre-labeled containers or bags were then placed in an icebox.

In some cases where the substrata were too hard, portions of rocks and coral reefs were also collected. For such samples hammer and chisel were used to expose and extract the animals,

which were sheltered in the rocks. The animals were then carefully transferred to bottles and formaldehyde was then added as to submerge the whole specimen. Most of the larger animals were identified on- board. All the samples of sediment, biota etc. after initial on-board-processing were frozen in an ice bath and finally shifted to deep freezer at –20°C within 3-4 hours of sample collection. All these samples were kept at –20°C until final transportation to the laboratories.

The grain size analysis was made by drying the sand on blotting papers at room temperature for 2 days. The dried sediment (100 gm) was weighed on a Galaxy 400 balance and sieved over a set of nested sieves of appropriate mesh size under vibration for 15 minutes. The separated fractions on each sieve were carefully transferred to a dish for weighing and the percentage of different fractions was calculated.

Results and Discussion

Northern Coastal Areas

Species Composition

A total of 204 species/groups pertaining to 106 families were identified and number of specimens counted which included 2 Chlorophyta, 7 Rhodophyta and 3 Phaeophyta species of marine plants were recorded in the present study whereas the fauna included 6 sponges, 15 cnidarians, 7 polychaets, 8 crabs, 6 caridean shrimps, 5 anomurans, 2 thalassinids, 1 mantis shrimp, 40 gastropods, 41 bivalves, 2 scaphopods, 2 chitons, 1 echinoid, 3 asteroids, 1 ophioroid and 1 holothuriod. The other groups were in negligible numbers. The individual number per station in the study area varied from 0-360 (Figure 4) . The richest station having the highest number of taxa was A-1000. In order of number downward the taxa ranked second and third at stations C 1000 and B 500, respectively. The lowest number was recorded at station D 250 and station D 500.

Abundance

The species dominance is based on the highest number of individuals for a given species. The polychaets were the most abundant group followed by gastropods on the northern side. The Station A-5000, which is also a reference station, has the highest number (360) of animals per square meter. The fauna had 4 dominant species (Figure 5). The most frequent one was *Padina pavonia*. The polychaets, mollusks and crustaceans were the constant feature at all stations. Among the gastropods the most dominant species was *Cerithium* sp. and among the bivalves the *Lithophaga* spp was the most dominant. All the specimens of stomatopods were monospecific (*Gonodactylus demanii*). The brachyuran crabs and porcellanids were 90% female specimens in ovigerous condition.

Eastern Coastal Areas

Species Composition

A total of 171 species/groups pertaining to 106 families were identified and the individuals per haul counted. Among the flora 2 green algae, 8 red algae, 4 brown algae and one sea grass species were identified. The zoobenthos included 6 sponges, 3 cnidarians including corals, 7 polychaets, 3 porcellanid crabs, 1 mantis shrimp, 6 brachyuran crabs, 3 caridean shrimps, 42 gastropods, 2

scaphopods, 34 bivalves, 2 chitons, 1 ophiuroid and 1 holothurian. The individual zoobenthos per station on the eastern coast varied from 1-896. The maximum diversity was present at two stations (F 250 and H 5000).

Abundance

The most abundant group on the eastern side was Gastropoda and Stomatopoda *Gonodactylus demani* was the least abundant (Figure 6). The richest station was F 250 and the thinnest population was found at Station H-2500 (Figure 7).

Conclusions

A total of 204 species of biota from the northern side was identified while 171 species from the eastern side. Polychaeta, Gastropoda and bivalvia were the most dominant groups both on the eastern and northern sides. In comparison with other northern locations in Qatar (Jones 1985) the coastal areas of Ras Laffan displayed increased biodiversity and productivity.

References

- CH2M Hill (1995) Bibliographic Review (Part I), Environmental Baseline Survey (Part II) and Site Characterization Report (Part III) - CH2M Hill International LTD in association with Continental Shelf Associates (CUES) and Gulf Consulting Group, June 1995.

- CH2M Hill International Limited (1996) Environmental Impact Assessment, Qatar Liquefied Gas Company LTD, Ras Laffan LNG Company LTD, Doha, Qatar. CH2M Hill International Ltd. January 1996;

- Hunting Surveys Limited, (1985) Preliminary Report. P1 platform site survey and P1 Ras Laffan pipe route survey, North Field Qatar. Prepared for Qatar General Petroleum Corporation. 40pp.

- Jones, D. A.1985. Proceeding of ROPME Symposium on Regional Marine Pollution Monitoring and Research Programe (ROPME/GC-4/2) 71-89.

- SARC (1999) Baseline ecological survey for Ras Laffan Marine Area, north and south of Ras Laffan Port. August 1998 and February 1999. Survey programme conducted by the Scientific and Applied Research Centre, University of Qatar (SARC)

- SARC (1999d) Ras Laffan baseline ecological survey, Chemical survey, Final Report. December 1999.

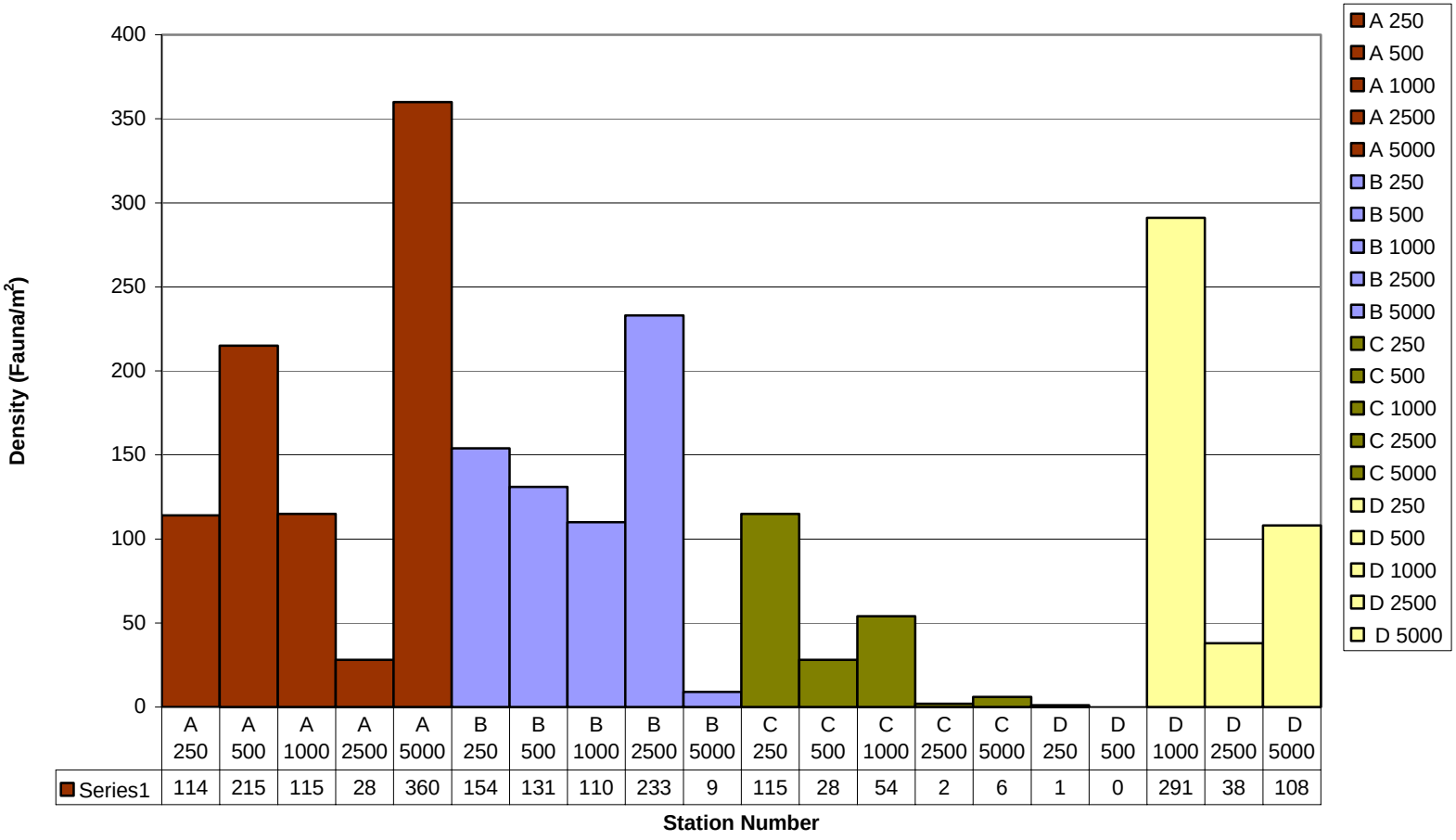

Figure 4. Density of Fauna/m2 on the Northern Coast of Ras Laffan

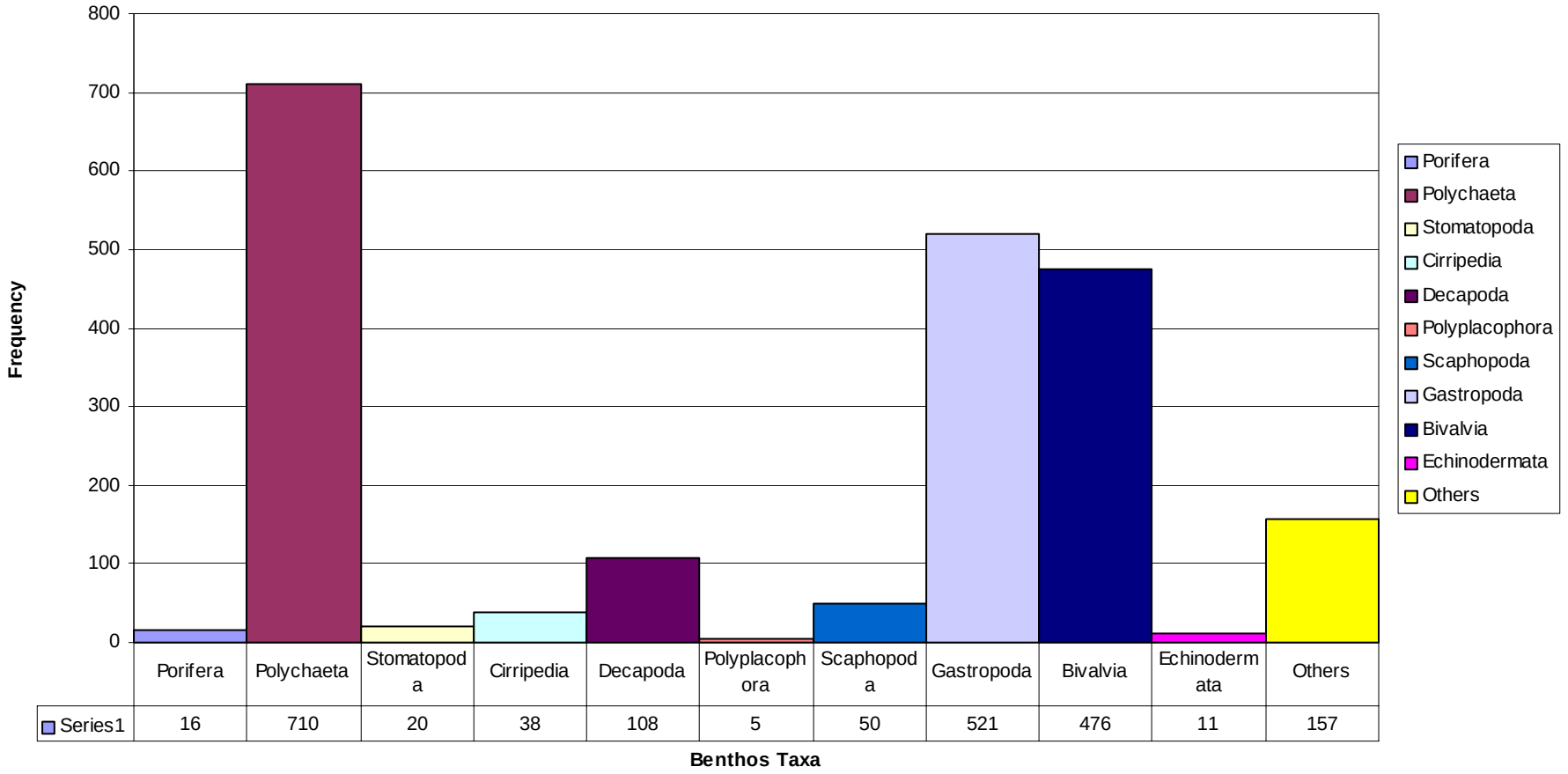

Figure 5. Occurrence and Abundance of Major Groups on the Northern Coast of Ras Laffan

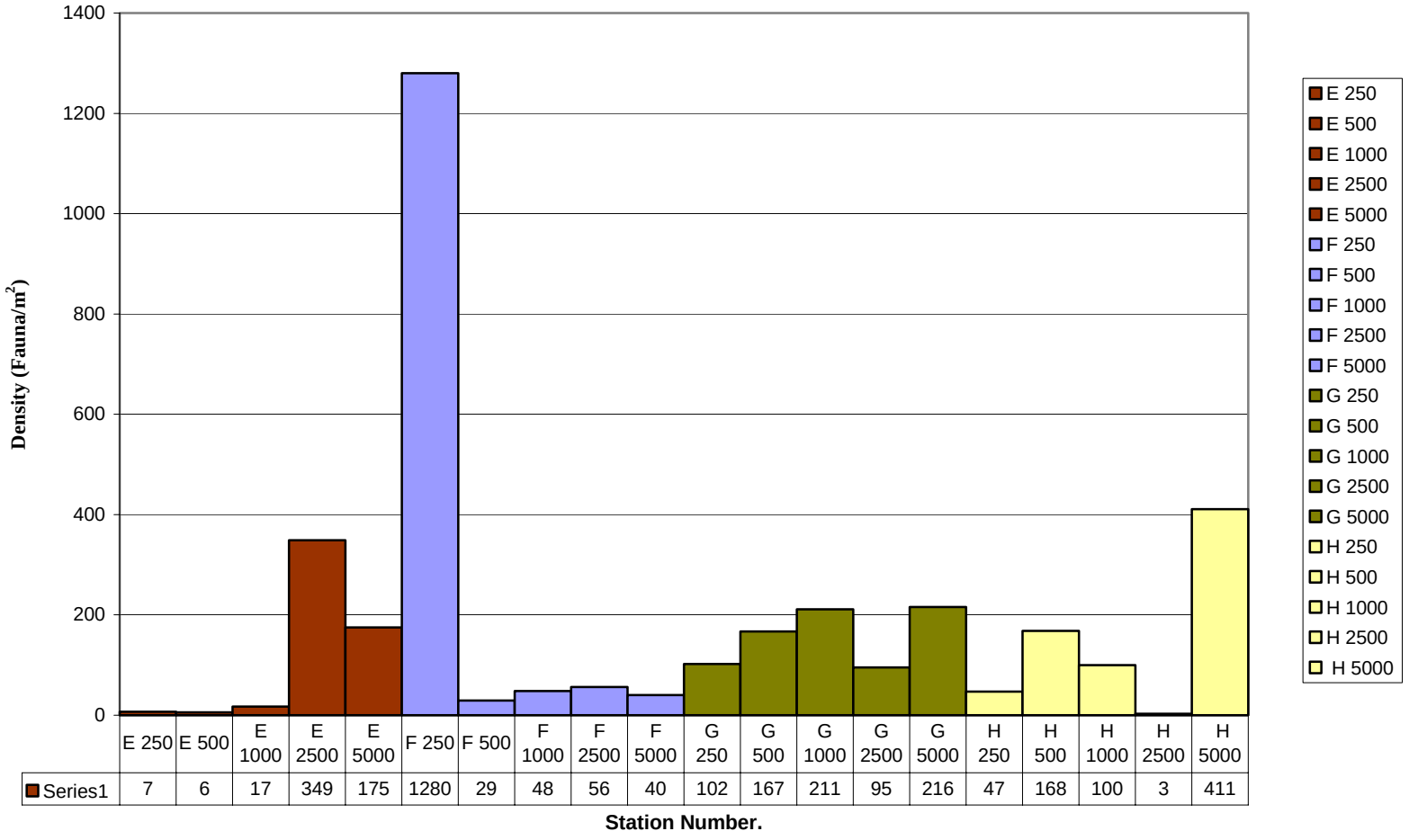

Figure 6. Density of Fauna/m^2 on the Eastern Coast of Ras Laffan

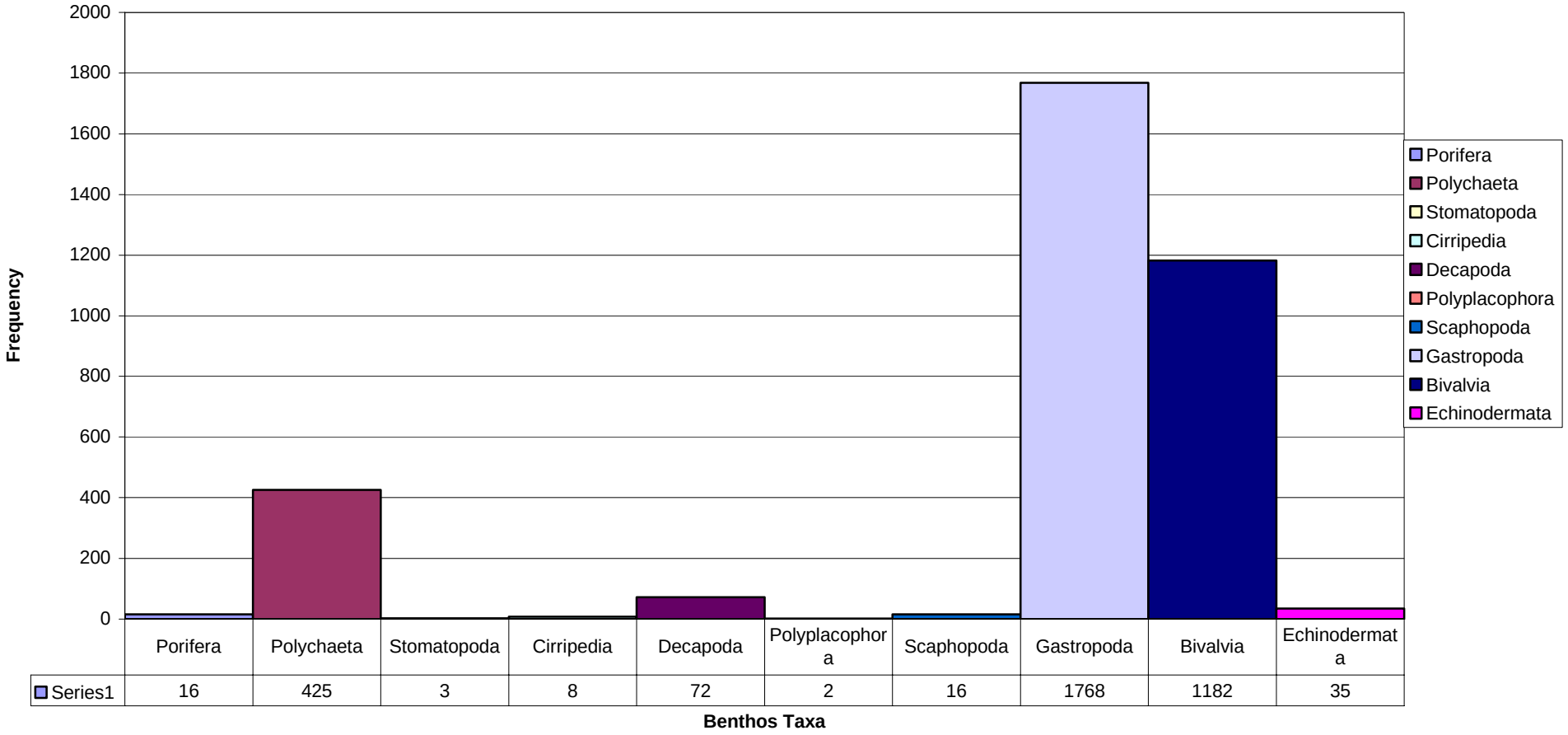

Figure 7. Occurrence and Abundance of Major Groups on the Eastern Coast of Ras Laffan